

CLAIMS

1. An apparatus for embedding data in information material, said data including a plurality of data items, said data items having a different relative importance with respect to each other, said apparatus comprising

5 an encoding processor operable to encode each of said data items in accordance with at least one error correction code, said encoded data items including redundant data introduced by said error correction code, and

a combining processor operable to combine said encoded data items with said information material, wherein said combining processor is operable in combination
10 with said encoding processor to allocate an amount of a limited data embedding capacity provided by said material information, and

to generate an amount of said redundant data included in said encoded data items in accordance with said allocation, each of said data items being encoded and embedded to the effect that a proportion of said limited data embedding capacity is
15 allocated to said encoded data items in accordance with said relative importance.

2. An apparatus as claimed in Claim 1, wherein said encoding processor includes a modulator operable to generate predetermined data sequences and to encode said data items by modulating said predetermined data sequences with data symbols of
20 said data items, and to combine said modulated predetermined data sequences with said information material.

3. An apparatus as claimed in Claim 2, wherein said predetermined data sequences are Pseudo-Random Symbol or Bit Sequences.

25 4. An apparatus as claimed in Claim 1, wherein said data items include meta data describing the content or providing an indication of an attribute of said information material in which the data is embedded.

5. An apparatus as claimed in Claim 4, wherein said meta data includes a Unique Material Identifier (UMID), said UMID being given a higher predetermined relative importance than other meta data.

5 6. An apparatus as claimed in Claim 5, wherein said UMID includes a plurality of data fields each of said fields representing a data item, each of said fields having a different relative importance.

7. An apparatus as claimed in Claim 1, wherein said combining processor
10 is operable in combination with said encoding processor not to embed selected data items if said limited capacity has been reached.

8. An apparatus as claimed in Claim 1, comprising a control processor
operable to receive data indicative of said relative importance of said data items to be
15 embedded and to control said encoding processor and said combining processor to encode and embed said data items in accordance with said relative importance, and to embed control information in the information material indicative of at least one of the encoding and embedding applied to said data items.

20 9. An apparatus as claimed in Claim 1, wherein said information material is an image.

10. An apparatus for embedding data in information material, said data
including a plurality of data items, said data items having a different relative
25 importance with respect to each other, said apparatus comprising

an encoding processor operable to encode each of said data items said encoding
processor is operable to encode said data items in accordance with at least one error
correction code, said encoded data items including redundant data introduced by said
error correction code,

30 a combining processor operable to combine said encoded data items with said
information material in accordance with an application strength,

wherein and said combining processor is operable in combination with said encoding processor to allocate an amount of a limited data embedding capacity provided by said material information, and

each of said data items are encoded and embedded to the effect that said proportion of said limited data embedding capacity and said application strength are allocated to said encoded data items in accordance with said relative importance.

11. An apparatus as claimed in Claim 10, wherein said encoding processor includes a modulator operable to generate predetermined data sequences and to encode said data items by modulating said predetermined data sequences with data symbols of said data items, and to combine said modulated predetermined data sequences with said information material.

12. An apparatus as claimed in Claim 11, wherein said predetermined data sequences are Pseudo-Random Symbol or Bit Sequences.

13. An apparatus as claimed in Claim 10, wherein said data items include meta data describing the content or providing an indication of an attribute of said information material in which the data is embedded.

14. An apparatus as claimed in Claim 13, wherein said meta data includes a Unique Material Identifier (UMID), said UMID being given a higher predetermined relative importance than other meta data.

15. An apparatus as claimed in Claim 14, wherein said UMID includes a plurality of data fields each of said fields representing a data item, each of said fields having a different relative importance.

16. An apparatus as claimed in Claim 10, wherein said combining processor is operable in combination with said encoding processor not to embed selected data items if said limited capacity has been reached.

17. An apparatus as claimed in Claim 10, comprising a control processor operable to receive data indicative of said relative importance of said data items to be embedded and to control said encoding processor and said combining processor to encode and embed said data items in accordance with said relative importance, and to
5 embed control information in the information material indicative of at least one of the encoding and embedding applied to said data items.

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19. An apparatus as claimed in Claim 10, wherein said information material is an image.

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20. An apparatus for embedding data in information material, said data including a plurality of data items, said data items having a different relative importance with respect to each other, said apparatus comprising

an encoding processor operable to encode each of said data items, and
15 a combining processor operable to combine said encoded data items with said information material, wherein said information material provides a limited data embedding capacity, and said encoding processor includes a modulator operable to generate predetermined data sequences and to encode said data items by modulating said predetermined data sequences with data symbols of said data items, and to
20 combine said modulated predetermined data sequences with said information material, wherein said predetermined data sequences are allocated to the effect that a greater amount of spreading of said data items is provided to the more important data items in accordance with said limited data embedding capacity.

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21. An apparatus as claimed in Claim 20, wherein said predetermined data sequences are Pseudo-Random Symbol or Bit Sequences.

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22. An apparatus as claimed in Claim 20, wherein said data items include meta data describing the content or providing an indication of an attribute of said
30 information material in which the data is embedded.

23. An apparatus as claimed in Claim 20, wherein said meta data includes a Unique Material Identifier (UMID), said UMID being given a higher predetermined relative importance than other meta data.

5 24. An apparatus as claimed in Claim 20, wherein said UMID includes a plurality of data fields each of said fields representing a data item, each of said fields having a different relative importance.

25. An apparatus as claimed in Claim 20, wherein said combining
10 processor is operable in combination with said encoding processor not to embed selected data items if said limited capacity has been reached.

26. An apparatus as claimed in Claim 20, comprising a control processor
15 operable to receive data indicative of said relative importance of said data items to be embedded and to control said encoding processor and said combining processor to encode and embed said data items in accordance with said relative importance, and to embed control information in the information material indicative of at least one of the encoding and embedding applied to said data items.

20 27. An apparatus as claimed in Claim 20, wherein said information material is an image.

28. An apparatus for detecting and recovering data embedded in
information material using the apparatus, said apparatus comprising

25 a detection processor operable to detect and to generate a recovered version of said embedded encoded data items from said information material, and

a decoding processor operable to decode and to recover said data items in
accordance with the encoding applied to said recovered encoded data items according
to the relative importance of said data items, wherein said detection processor is
30 operable to detect and to recover said control information, and in accordance with said control information to decode and to recover said data items.

28. A method of embedding data in information material, said data being a plurality of data items each having a different relative importance, said method comprising

5 allocating an amount of a limited data embedding capacity provided by said material information,

encoding each of said data items in accordance with at least one error correction code, said encoded data items including redundant data introduced by said error correction code, an amount of said redundant data included in said encoded data items being allocated in accordance with said relative importance, and

10 combining said encoded data items with said information material, wherein said allocating and generating has an effect that a proportion of said limited data embedding capacity is allocated to said encoded data items in accordance with said relative importance.

29. A method of embedding data in information material, said data being a plurality of data items each having a different relative importance, said method comprising

15 allocating an amount of a limited data embedding capacity provided by said material information in accordance with an application strength,

20 encoding each of said data items in accordance with at least one error correction code, said encoded data items including redundant data introduced by said error correction code, an amount of said redundant data included in said encoded data items being allocated in accordance with said relative importance, and

25 combining said encoded data items with said information material, wherein said allocating and generating has an effect that a proportion of said limited data embedding capacity is allocated to said encoded data items in accordance with said relative importance, wherein each of said data items are encoded and combined to the effect that said proportion of said limited data embedding capacity and said application strength are allocated to said encoded data items in accordance with said relative
30 importance.

31. A method of embedding data in information material, said data being a plurality of data items each having a different relative importance, said method comprising

5 allocating an amount of a limited data embedding capacity provided by said material information,

encoding each of said data items in accordance with at least one error correction code, said encoded data items including redundant data introduced by said error correction code, an amount of said redundant data included in said encoded data items being allocated in accordance with said relative importance, and

10 generating predetermined data sequences,

encoding said data items by modulating said predetermined data sequences with data symbols of said data items, and

combining said modulated predetermined data sequences with said information material,

15 wherein said predetermined data sequences are allocated to the effect that a greater amount of spreading of said data items is provided to the more important data items in accordance with said limited data embedding capacity.

32. A method of embedding data in information material, said data being a plurality of data items each having a different relative importance, said method comprising

20 receiving data indicative of said relative importance of said data items to be embedded,

encoding each of said data items,

25 combining said encoded data items with said information material within a limited data embedding capacity provided by said information material, said encoding and said combining of said data items being performed in accordance with said received relative importance of said data items, to the effect that a proportion of said limited data embedding capacity is allocated to said data items in accordance with said relative importance, and

30 embedding control information indicative of at least one of the encoding and embedding applied to said data items.

33. ^{7/} A method of detecting and recovering data embedded in information material according to the method claimed in Claim 32, said method comprising
detecting said embedded encoded data from said information material to
5 generate a recovered version of said encoded data, and
decoding said encoded data items to generate a recovered version of said data items in accordance with the encoding applied to said encoded data items according to the relative importance of said data items.

10 ~~34.~~³ An apparatus for embedding data in information material, said data including a plurality of data items, said apparatus comprising
a combining processor operable to combine said encoded data items with said information material, said information material providing a limited data embedding capacity, and
15 a control processor operable to select said data items in accordance with an order of relative importance and to control said combining processor to embed said selected data items in said information material within said limited data embedding capacity, said control processor selecting said data items to the effect that more important data items are embedded before less important data items until said data
20 embedding capacity limit is reached.

~~35.~~^{2/} An apparatus as claimed in Claim 34, wherein said data items include meta data describing the content or providing an indication of an attribute of said information material in which the data is embedded.

25 ~~36.~~³ An apparatus as claimed in Claim 35, wherein said meta data includes a Unique Material Identifier (UMID), said UMID being given a higher predetermined relative importance than other meta data.

30 ~~37.~~⁶ An apparatus as claimed in Claim 34, wherein said control processor is arranged to queue at least one data item which is not embedded within said limited data embedding capacity until sufficient data embedding capacity within said limit is

available, and controls said combining processor to select at least one queued data item and embeds the selected queued data item in said material information.

38.⁷ A signal representing information material in which data has been
5 embedded by an apparatus according to Claim 1.

39.⁸ A signal representing information material in which data has been
embedded by an apparatus according to Claim 10.

10 40.¹⁰ A signal representing information material in which data has been
embedded by an apparatus according to Claim 20.

41.⁹ A computer program providing computer executable instructions,
which when loaded on to a data processor configures said data processor to operate as
15 an apparatus according to Claim 1.

42.¹ A computer program providing computer executable instructions,
which when loaded on to a data processor configures said data processor to operate as
an apparatus according to Claim 10.

20 43.² A computer program providing computer executable instructions,
which when loaded on to a data processor configures said data processor to operate as
an apparatus according to Claim 20.

25 44.³ An apparatus for detecting and recovering data embedded in
information material, said data comprising a plurality of source data items each having
been encoded in accordance with a systematic error correction code to produce
encoded data items each comprising the corresponding source data item and redundant
data, said encoded data items being embedded in the information material, said
30 apparatus comprising

an embedded data detector operable to detect and generate a recovered version
of said encoded data from said information material,

an error processor operable, for each of said recovered encoded data items, to determine whether said recovered encoded data item is deemed too errored, and if not, decoding said encoded data item to generate a recovered version of said data item,

a data store for storing said recovered version of said data item, and

- 5 a recovery data processor operable, if said error processor determines that one of said recovered encoded data items is deemed too errored, to compare the source data item of said encoded data item, with at least one other source data item from said data store, and to estimate said source data item of said errored encoded data item in dependence upon a corresponding value of said at least one other recovered data item.

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45. An apparatus as claimed in Claim 44, wherein said error processor is operable to determine whether each of said recovered encoded data items is errored by estimating the number of errored data symbols in each of said recovered encoded data items, and to compare said number of errors with a predetermined threshold, said
15 recovered encoded data item being determined as errored if said number of errors is greater than or equal to said threshold.

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46. An apparatus as claimed in Claim 44, wherein said recovery processor is operable to compare said source data item from said errored encoded data item with at least one of a previous and a subsequent decoded and recovered data item, and to replace said source data item of said errored encoded data item in accordance with at least one of said previous and subsequent source data items.

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47. An apparatus as claimed in Claim 46, wherein said recovery processor is operable, if said previous and said subsequent source data items have the same value to replace said source data item of said errored encoded data item with the value of said previous or subsequent data items.

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48. An apparatus as claimed in Claim 46, wherein said recovery processor is operable, if said previous and said subsequent source data items have different values to replace said source data item of said errored encoded data item with the value formed by interpolating between said previous and subsequent data items.

49. An apparatus as claimed in Claim 44, comprising an analysis processor operable to compare the content of the information material from which a plurality of recovered source data items and said errored encoded data item have been detected, and to generate data representative of the comparison, wherein said recovery processor is operable to estimate said source data item of said errored encoded data item in dependence upon said data representative of said comparison.

50. An apparatus as claimed in Claim 44, wherein each of said source data items comprises a plurality of data fields, and said recovery processor is operable to compare at least one of said data fields of said errored encoded data item with the corresponding field of said at least one other recovered data item, and to replace said at least one of said fields of said errored encoded data item with the corresponding field of said recovered data item in accordance with said comparison.

51. An apparatus as claimed in Claim 50, wherein said recovery processor is operable, in dependence upon at least one of said data fields of said source data item being replaced, to determine in combination with said error processor whether said recovered encoded data item in which the data field is replaced is deemed to be too errored, and if not, decoding said encoded data item to form a recovered version of said data item.

52. An apparatus as claimed in Claim 50, wherein said recovery processor is operable, if said corresponding data field of a previous and a subsequent data items have the same value, to set said data field of said errored encoded data item to the value of one of said previous and subsequent data items.

53. An apparatus as claimed in Claim 50, wherein said recovery processor is operable, if said corresponding data field of a previous data item and a subsequent data item have different values, to replace said data field of said errored encoded data item with a value formed by interpolating between said previous and subsequent data items.

54. An apparatus as claimed in Claim 50, wherein said recovery processor is operable, to determine the difference between said corresponding data field of a previous data item and said corresponding data field of a subsequent data item, and if said difference is above a predetermined threshold to replace said data field of said errored encoded data item which cannot be decoded with the value of said field of said previous data item and otherwise to form said replacement value by interpolating between said field of said previous and subsequent data items.

55. An apparatus as claimed in Claim 50, comprising an analysis processor operable to compare the content of the information material from which a previous data item, a subsequent data item and said errored encoded data items were detected, and to generate data representative of the comparison, wherein said recovery processor is operable to replace said data field of said errored encoded data item which cannot be decoded with the value of said data field from one of said previous and said subsequent data items in dependence upon said comparison data.

56. An apparatus as claimed in Claim 55, wherein said analysis processor is arranged to estimate the content of the information material from a colour histogram or the like.

57. An apparatus as claimed in Claim 44, wherein said information material is at least one of video, audio, data or audio/video material, and said source data items include meta data describing the content or attributes relating to said video, audio, data or audio/video material.

58. An apparatus as claimed in Claim 57, wherein said data items include Unique Material Identifiers (UMIDs), and said data fields are the fields of said UMID, and said encoded data items are encoded UMIDs.

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59. An apparatus as claimed in Claim 58, wherein the data field of an errored encoded UMID, which is recovered by interpolating contains data representative of the time code of said UMID.

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60. An apparatus as claimed in Claim 58, wherein the data field of an errored encoded UMID, which is recovered by replacing the data field with data from the corresponding field of the previous encoded UMID, consequent upon a difference between the data fields of the previous and subsequent recovered UMIDs being above a predetermined threshold is representative of a clip identifier of said UMID.

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61. An apparatus for embedding data into information material, said data comprising a plurality of source data items, said apparatus comprising
an error correction encoder operable to encode each of said data items in accordance with a systematic error correction code to produce encoded data items each comprising the source data item and redundant data, and
a combining processor operable to combine said encoded data items with said information material.

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62. An apparatus as claimed in Claim 61, wherein said data items include meta data such as UMIDs or the like.

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63. A signal representative of information material in which data have been embedded by the apparatus claimed in Claim 61.

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64. A system for embedding and removing data from information material, said system comprising
an apparatus for embedding the data into the information material according to Claim 61, and
an apparatus for detecting and removing the data from the information material according to Claim 44.

⁶⁵ 65. A method of detecting and recovering data embedded in information material, said data comprising a plurality of source data items each having been encoded in accordance with a systematic error correction code to produce encoded data items, each encoded data item comprising the corresponding source data item and
5 redundant data, said encoded data items being embedded in the information material, said method comprising

detecting and generating a recovered version of said encoded data items from said information material,

⁶⁶ 66. determining, for each of said encoded data items, whether the recovered
10 version of said encoded data item is deemed too errored, and
if not, decoding said encoded data item to generate a recovered version of said data item, and storing said recovered version of said data item, and

if said errored encoded data item is deemed too errored, comparing said source data from said errored encoded data item with at least one other source data item from
15 said data store, and estimating said source data item of said errored encoded data item in dependence upon a corresponding value of said other recovered data item.

⁶⁷ 67. A method of embedding data in information material, said data comprising a plurality of source data items, said method comprising
20 encoding each of said data items in accordance with a systematic error correction code to produce encoded data items each comprising the corresponding said source data item and redundant data, and
combining said encoded data items with said information material.

⁶⁸ 68. A computer program providing computer executable instructions,
25 which when loaded on to a data processor configures said data processor to operate as an apparatus according to Claim 44.

⁶⁹ 69. A computer program having computer executable instructions, which
30 when loaded on to a data processor causes the data processor to perform the method according to Claim 65.

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~~69.~~ A computer program product having a computer readable medium having recorded thereon information signals representative of the computer program claimed in Claim 67.

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70. A computer program product having a computer readable medium having recorded thereon information signals representative of the computer program claimed in Claim 68.

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71. An apparatus for embedding data in information material, said data
10 being a plurality of data items each having a different relative importance, said apparatus comprising

means for allocating an amount of a limited data embedding capacity provided by said material information,

means for encoding each of said data items in accordance with at least one
15 error correction code, said encoded data items including redundant data introduced by said error correction code, an amount of said redundant data included in said encoded data items being allocated in accordance with said relative importance, and

means for combining said encoded data items with said information material, wherein said allocating and generating has an effect that a proportion of said limited
20 data embedding capacity is allocated to said encoded data items in accordance with said relative importance.

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~~72.~~ An apparatus for embedding data in information material, said data
25 being a plurality of data items each having a different relative importance, said apparatus comprising

means for allocating an amount of a limited data embedding capacity provided by said material information in accordance with an application strength,

means for encoding each of said data items in accordance with at least one
30 error correction code, said encoded data items including redundant data introduced by said error correction code, an amount of said redundant data included in said encoded data items being allocated in accordance with said relative importance, and

means for combining said encoded data items with said information material, wherein said allocating and generating has an effect that a proportion of said limited data embedding capacity is allocated to said encoded data items in accordance with said relative importance, wherein each of said data items are encoded and combined to the effect that said proportion of said limited data embedding capacity and said application strength are allocated to said encoded data items in accordance with said relative importance.

73. An apparatus for embedding data in information material, said data being a plurality of data items each having a different relative importance, said apparatus comprising

means for allocating an amount of a limited data embedding capacity provided by said material information,

means for encoding each of said data items in accordance with at least one error correction code, said encoded data items including redundant data introduced by said error correction code, an amount of said redundant data included in said encoded data items being allocated in accordance with said relative importance, and

means for generating predetermined data sequences,

means for encoding said data items by modulating said predetermined data sequences with data symbols of said data items, and

means for combining said modulated predetermined data sequences with said information material,

wherein said predetermined data sequences are allocated to the effect that a greater amount of spreading of said data items is provided to the more important data items in accordance with said limited data embedding capacity.

74. An apparatus for embedding data in information material, said data being a plurality of data items each having a different relative importance, said apparatus comprising

means for receiving data indicative of said relative importance of said data items to be embedded,

means for encoding each of said data items,

means for combining said encoded data items with said information material within a limited data embedding capacity provided by said information material, said encoding and said combining of said data items being performed in accordance with said received relative importance of said data items, to the effect that a proportion of said limited data embedding capacity is allocated to said data items in accordance with said relative importance, and

means for embedding control information indicative of at least one of the encoding and embedding applied to said data items.

75. An apparatus for detecting and recovering data embedded in information material, said apparatus comprising

means for detecting said embedded encoded data from said information material to generate a recovered version of said encoded data, and

means for decoding said encoded data items to generate a recovered version of said data items in accordance with the encoding applied to said encoded data items according to the relative importance of said data items.

76. An apparatus for detecting and recovering data embedded in information material, said data comprising a plurality of source data items each having been encoded in accordance with a systematic error correction code to produce encoded data items, each encoded data item comprising the corresponding source data item and redundant data, said encoded data items being embedded in the information material, said apparatus comprising

means for detecting and generating a recovered version of said encoded data items from said information material,

means for determining, for each of said encoded data items, whether the recovered version of said encoded data item is deemed too errored, and

means for decoding said encoded data item if said encoded data item is not too errored, to generate a recovered version of said data item, and storing said recovered version of said data item, and

if said errored encoded data item is deemed too errored, means for comparing said source data from said errored encoded data item with at least one other source

data item from said data store, and means for estimating said source data item of said errored encoded data item in dependence upon a corresponding value of said other recovered data item.

- 5 27. ⁷⁶ An apparatus for embedding data in information material, said data comprising a plurality of source data items, said apparatus comprising
- means for encoding each of said data items in accordance with a systematic error correction code to produce encoded data items each comprising the
- corresponding said source data item and redundant data, and
- 10 means for combining said encoded data items with said information material.